




How does home literacy environment influence reading comprehension in Chinese? Evidence from a 3-year longitudinal study

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Abstract

Although several studies have examined the role of home literacy environment (HLE) in learning to read in Western societies, little is known about the role of HLE in Chinese reading. In addition, the few studies in Chinese have not tested the possible effects of HLE on reading comprehension. Thus, the purpose of this study was to examine the direct and indirect effects of different aspects of HLE (formal literacy experiences, informal literacy experiences, and access to literacy resources) on reading comprehension in Chinese. One hundred fifty-nine third year kindergarten children (70 girls and 89 boys; $M_{\text{age}} = 72.62$ months) participated in the study. In kindergarten, they were assessed on emergent literacy skills (vocabulary, phonological awareness, pinyin knowledge, rapid naming), in Grade 1, on word reading, and, in Grade 2, on reading comprehension. In addition, parents filled out a questionnaire on their education and income, the frequency of different HLE activities, the number of children's books at home, and their expectations, when their children were in kindergarten. Results of structural equation modeling showed that formal literacy experiences predicted reading comprehension through the effects of pinyin knowledge on word reading. Access to literacy resources predicted reading comprehension through the effects of rapid naming, phonological awareness, and vocabulary. Finally, informal literacy experiences did not predict any of the emergent literacy skills or reading outcomes. Our findings provide only partial support of the home literacy model and suggest that the culture in which environmental effects take place may determine what aspects of the home literacy environment contribute to children's reading performance and what not.

Keywords Chinese · Home literacy environment · Pinyin · Reading comprehension · Word reading

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Introduction

Several studies have established that home literacy environment (HLE), an umbrella concept that encapsulates a variety of child-parent activities related to literacy, is a significant predictor of children's language and literacy development across a variety of languages (e.g., Hood, Conlon, & Andrews, 2008; Inoue, Georgiou, Parrila, & Kirby, 2018; Liu, Georgiou, & Manolitsis, 2018; Manolitsis, Georgiou, & Parrila, 2011; Niklas & Schneider, 2013; Silinskas et al., 2012). Given that children spend more time at home than at school, it is reasonable to expect that the quality and quantity of the literacy-related activities in which parents engage their children should matter for their children's literacy development.

To describe the nature of these HLE activities and the way they impact reading, Sénéchal and LeFevre (2002) proposed the home literacy model (see below). Although several studies have generally supported the premises of the home literacy model (e.g., Inoue et al., 2018; Manolitsis et al., 2011; Sénéchal & LeFevre, 2014; Silinskas, Torppa, Lerkkanen, & Nurmi, 2019; Skwarchuk, Sowinski, & LeFevre, 2014), the evidence comes primarily from studies conducted in Western countries with relatively affluent societies. Thus, we aimed to test the premises of the home literacy model in an East Asian culture (i.e., Chinese). This is important in view of Bronfenbrenner's (1979) ecological systems theory according to which cultural expectations of achievement and orthographies to be learned (i.e., the elements of macrosystem) impact children's academic achievement.

The home literacy model

According to the home literacy model (Sénéchal, 2006; Sénéchal & LeFevre, 2002), there are two types of literacy experiences taking place at home: the informal and the formal home literacy experiences.¹ Informal literacy experiences are meaning-focused and expose children to print incidentally through activities such as shared book reading. In turn, formal literacy experiences are code-focused and expose children to print directly through activities such as teaching of letters and words. The two types of literacy experiences correlate weakly with each other (e.g., Deng, Silinskas, Wei, & Georgiou, 2015; Hamilton, Hayiou-Thomas, Hulme, & Snowling, 2016; Manolitsis et al., 2011; Sénéchal, 2006) and predict different language and literacy outcomes.

The informal literacy experiences appear to contribute more to vocabulary than to letter knowledge, phonological awareness, or word reading (e.g., Evans, Shaw, & Bell, 2000; Hood et al., 2008; Sénéchal, 2006; Sénéchal & LeFevre, 2014). Studies have further shown that vocabulary mediates the effects of informal literacy

¹ We acknowledge that some researchers have adopted a broader conceptualization of HLE that includes a combination of home literacy activities and contextual variables (e.g., demographic characteristics), child characteristics (e.g., temperament), mother-child interactions (e.g., maternal responsiveness), and parent-child joint activities (e.g., watching TV) (see Britto & Brooks-Gunn, 2001; Curry, 2012; Payne, Whitehurst, & Angell, 1994; Umek, Podlesek, & Fekonja, 2005).

experiences on word reading (e.g., Manolitsis, Georgiou, & Tziraki, 2013; Roth, Speece, & Cooper, 2002; Torppa et al., 2007) and reading comprehension (e.g., Hamilton et al., 2016; Inoue et al., 2018; Sénéchal & LeFevre, 2002). In turn, formal literacy experiences appear to contribute more to letter knowledge, phonological awareness, and word reading than to vocabulary (e.g., Evans et al., 2000; Manolitsis et al., 2011; Sénéchal & LeFevre, 2002). Letter knowledge and phonological awareness have also been found to mediate the effects of formal literacy experiences on word reading (e.g., Evans et al., 2000; Hood et al., 2008; Inoue et al., 2018) and reading comprehension (e.g., Hamilton et al., 2016; Sénéchal, 2006). Additionally, previous studies have shown that the effects of both informal and formal literacy experiences on later reading outcomes are fully mediated by emergent literacy skills including phoneme awareness and letter knowledge (e.g., Hamilton et al., 2016; Inoue et al., 2018; Sénéchal & LeFevre, 2014).

Bourdieu (1986) proposed that the cultural capital to which an individual has access to is also a key component of the HLE. Cultural capital includes cultural objects (e.g., art work) and resources (e.g., books), as well as the ability to access, utilize, and learn from these objects and resources. Several studies have shown that access to literacy resources plays an important role in children's literacy skills over and above informal and formal literacy experiences (e.g., Chiu & McBride-Chang, 2006; Netten, Droop, & Verhoeven, 2011; Ruan, Zhou, & Li, 2006; van Bergen, van Zuijen, Bishop, & de Jong, 2016; Vasilyeva et al., 2018). To encourage children to explore literacy, parents need to provide access to print resources and literacy materials. Access to literacy resources has traditionally been measured by asking parents to report on the number of children's books at home (e.g., Esmaeeli, Kyle, & Lundetræ, 2019; Shu, Li, Anderson, Ku, & Yue, 2002; Torppa et al., 2007) and on the frequency of visiting a library/bookstore with their child (e.g., Esmaeeli et al., 2019; Silinskas et al., 2013; Torppa et al., 2007). However, some researchers have also treated these items as indicators of informal home literacy experience (e.g., Hood et al., 2008; Inoue et al., 2018; Sénéchal, LeFevre, Thomas, & Daley, 1998). In view of this, it would be interesting to examine if it is access to literacy resources (including the number of children's books at home) or frequency of shared book reading that is driving the relation between informal literacy experiences and vocabulary knowledge by separating activities that parents do with their children from other variables in the informal literacy component. To address this issue, we treated access to literacy resources as an independent predictor of emergent literacy skills and reading.

Home literacy environment and literacy skills in Chinese

Although several studies have examined the role of HLE in literacy acquisition in Western countries (see Sénéchal, Whissell, & Bildfell, 2017, for a recent review), only a handful of studies have been conducted in Chinese and have produced mixed results (Deng et al., 2015; Lau & McBride-Chang, 2005; Li, Corrie, & Wong, 2008; Liu et al., 2018; Shu et al., 2002). For example, in a study with kindergarten children, Liu et al. (2018) found that formal literacy experiences predicted phonological

awareness, which, in turn, predicted word reading. Informal literacy experiences did not exert any direct or indirect effects on word reading. Liu et al. (2018) also showed that access to literacy resources was a significant predictor of vocabulary, which, in turn, predicted word reading. Similar to Liu et al. (2018), Li et al. (2008) found that formal literacy experiences (but not informal) at the age of 5 (kindergarten) predicted Chinese literacy (a composite score made up of character identification, visual and auditory discrimination, word recognition, and vocabulary) at the age of 8 (Grade 2). In contrast to Liu et al. (2018) and Li et al. (2008), Deng et al. (2015) reported no unique effects of formal literacy experiences (measured in Grade 1) on children's word reading in Grade 2, and, in contrast to all, Shu et al. (2002) showed that informal literacy experiences predicted children's reading ability in both Grades 1 and 4. Notice though that Shu et al. included vocabulary in the reading composite score, and this may have inflated the contribution of informal literacy experiences to reading.

Examining the role of HLE in Chinese is important for a number of reasons. First, as indicated by McBride (2015), there are important cultural differences between China and US including, but not limited to, attitudes towards academic achievement (i.e., Chinese children live in a society in which there is strong pressure to succeed academically; Zhang, Hu, Ren, Huo, & Wang, 2019) and parental beliefs about learning (i.e., Chinese parents attribute their children's success to hard work and American parents to their children's innate ability; Stevenson & Stigler, 1992) that may differentially affect how HLE contributes to children's reading acquisition across cultures.

Second, there are important differences between English and Chinese orthographies. Whereas English uses an alphabetic script in which letters correspond to phonemes, Chinese uses a logographic script in which the main graphic unit, the character, corresponds to a syllabic morpheme (Shu, 2003). Although ~80% of modern Chinese are compound characters containing a phonetic radical that gives some information about the character's pronunciation, the phonetic radical does not always provide reliable information on how the character should be pronounced. For this reason, before Chinese children are formally taught to recognize characters, they learn a phonetic transcription system (Pinyin)² to help them with the pronunciation of the characters. First and second graders in China are expected to recognize 1600–1800 characters and to write 800–1000 characters (Ministry of Education of the People's Republic of China, 2012). In light of this, we would expect Chinese parents to take an active role in teaching their children how to read and write Chinese characters well before they go to Grade 1. Indeed, previous studies with kindergarten children have reported high levels (i.e., teaching a few times a week) of

² Pinyin is an alphabetic coding system that spells out the sounds of Chinese characters using both Roman alphabet letters and lexical tone transcriptions. The pinyin system employs almost all Roman letters used in English (without <v>, but with the addition of <ü>) representing 21 onsets and 35 rimes (Institute of Linguistics, Chinese Academy of Social Sciences, 2004). For a review of studies on Pinyin and Chinese reading see Wang, Lam, Mo, and McBride-Chang (2014).

parental teaching (e.g., Lau & McBride-Chang, 2005; Li & Rao, 2000; Liu et al., 2018).

Third, although most North American parents believe it is the school's responsibility to teach their children reading (e.g., Evans et al., 2004; Evans & Koblinsky, 2017), in China, it appears to be the opposite. According to a survey by the Family Education Study Centre (2012), 60.9% of Chinese parents reported that it was their responsibility to teach their kindergarten children to read. In view of this, we would expect both formal and informal literacy experiences at home to predict Chinese children's future reading performance.

Finally, because of the one-child policy that was in effect for more than three decades in China, Chinese parents have been paying particular attention to their children's academic achievement by investing a significant amount of their income to educational resources and programs that would help their children succeed (e.g., Lu, 1999; Zhu & Yang, 2003). For example, Lu (1999) found that Chinese parents spend more than 20% of the family's budget on children's books, educational programs, and other children's items. Thus, access to literacy resources should play an important role in Chinese children's reading ability. Indeed, previous studies have provided evidence in support of this hypothesis (e.g., Lau & McBride-Chang, 2005; Liu et al., 2018; Su et al., 2017).

The present study

The purpose of this study was to examine how home literacy environment influences emergent literacy skills, word reading, and reading comprehension in a sample of Chinese children followed from kindergarten to Grade 2. Sénéchal's (2006) home literacy model and its recent modifications (e.g., the addition of family's SES and parents' expectations as antecedents of HLE aspects; see Liu et al., 2018; Vasilyeva et al., 2018) were used to guide our study. Based on the premises of the home literacy model as well as the findings of previous studies in Chinese (e.g., Lau & McBride-Chang, 2005; Li et al., 2008; Liu et al., 2018; Shu et al., 2002), we expected that:

- (1) Formal literacy experiences would contribute to pinyin knowledge, access to literacy resources would contribute to vocabulary, and informal literacy experiences would have limited effects on the emergent literacy skills (Liu et al., 2018; Sénéchal, 2006; Sénéchal & LeFevre, 2014).
- (2) Formal literacy experiences would contribute to word reading through the effects of pinyin knowledge and access to literacy resources would contribute to word reading through the effects of vocabulary (Manolitsis et al., 2013; Roth et al., 2002; Torppa et al., 2007).
- (3) The effects of formal literacy experiences on reading comprehension would be fully mediated by word reading and the effects of access to literacy resources would be fully mediated by vocabulary (Hamilton et al., 2016; Inoue et al., 2018; Sénéchal & LeFevre, 2014).

The findings of the present study are expected to make four important contributions to the literature. First, to our knowledge, this is the first study on HLE in Chinese to include measures of reading comprehension. Given that reading comprehension is the ultimate goal of reading and researchers have proposed specific links between formal/informal literacy experiences and reading comprehension (e.g., Hamilton et al., 2016; Inoue et al., 2018; Manolitsis et al., 2011; Sénéchal, 2006), it is important to examine if the same links can be found in Chinese. Second, because previous studies in Chinese have either used a composite score for reading (e.g., Li et al., 2008; Shu et al., 2002) or have assessed only word reading (e.g., Deng et al., 2015; Liu et al., 2018), we do not know if the different aspects of HLE predict different reading outcomes (as has been reported in previous studies in Western countries). Third, no studies on HLE have assessed children's pinyin knowledge, even though researchers have reported that Chinese parents teach pinyin to their kindergarten children (Liu et al., 2018; McBride-Chang et al., 2012). Subsequently, the findings of this study can reveal if formal literacy experiences influence word reading through the effects of pinyin knowledge. Finally, with the exception of Li et al.'s (2008) study, no other studies in Chinese have examined the role of HLE in literacy acquisition following the same children from kindergarten (before they receive formal reading instruction) to Grades 1 and 2 (after they receive formal reading instruction). This period is particularly important not only because Chinese children prepare to enter elementary school, but also because their home literacy experiences change compared to those reported for younger children (e.g., Zhang, Jin, Shen, Zhang, & Hoff, 2008). Notice also that Li et al.'s (2008) study included a relatively small sample (44 children from Beijing and 44 children from Hong Kong), which prevented the testing of any mediation models.

In this study, we have also controlled for the effects of family's socioeconomic status (SES; derived from parents' education and income) and parents' expectations. More educated and wealthier parents are more likely to engage in shared book reading and provide more frequent access to literacy resources, which, in turn, may translate into larger gains in their children's reading ability (e.g., Hartas, 2011; Liu, Peng, & Luo, 2019; van Steensel, 2006; see also Bronfenbrenner, 1979). Likewise, parents who hold high expectations of their children may provide the means for their children to succeed and they may also engage more frequently in their children's learning (e.g., Froiland, Pederson, & Davison, 2013; Martini & Sénéchal, 2012; Skwarchuk et al., 2014; Vasilyeva et al., 2018). Previous studies in Chinese have shown that these two factors are related to home literacy environment (Ip et al., 2016; Liu et al., 2018). For example, Liu et al. (2018) found that family's SES was predictive of access to literacy resources and parents' expectations was predictive of formal and informal literacy experiences as well as of access to literacy resources.

Method

Participants

One hundred fifty-nine Chinese children (70 girls and 89 boys; $M_{\text{age}} = 72.62$ months, $SD = 4.01$; range: 66–87 months) from Jining, Southwestern Shandong province, participated in this study (see Zhang et al., 2018, for details on how the same was recruited). All children were attending third year kindergarten (testing was conducted in April, Time 1), were native Mandarin speakers, and none were diagnosed with any intellectual, behavioral, or sensory deficits (based on teachers' report). The same children were reassessed at the beginning of Grade 1 (second and third week of October; Time 2) and at the middle of Grade 2 (second and third week of January; Time 3) when they were 78.63 and 94.22 months old, respectively. By Time 3, our sample consisted of 145 children (seven children moved to a different city and could not be located and another seven withdrew from the study). The children who withdrew from the study did not differ significantly from the rest of the children on any of the kindergarten measures (all $ps > .18$). Parental and school consent was obtained prior to testing.

The parents of the children also participated in the study (Time 1) by filling out a questionnaire on their education and income, the frequency of teaching their children to read and write characters and to read pinyin, the frequency of shared book reading, the number of children's books at home, the frequency of visits to libraries/bookstores, and their expectations for their child's future reading and writing ability (see Table 1, for the items of the parents' questionnaire). The items in the HLE questionnaire were sampled from Sénéchal (2006), Kirby and Hogan (2008), and Liu et al. (2018). Parents were also asked to record the daily parent–child reading activities (diary). The questionnaire was filled out by 97 mothers, 31 fathers, 17 families where parents responded together, and 2 families where one of the grandparents responded. The parents of 12 children did not fill out the questionnaire (see below for information on how we handled missing data).

Mothers' and fathers' median and mode education level was "technical secondary school or college". In turn, parents' average monthly income was between 6000 and 9000 Chinese Yuan (RMB). Both indices suggest that our participants were mostly coming from families of middle to upper middle socioeconomic background. These values also indicate that our sample was representative of the general population in Jining (Jining Municipal Bureau of Statistics, 2017).

Measures

Formal home literacy experiences (FHLE)

To assess FHLE we asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = very often) (a) the frequency of teaching their child to read Chinese characters, (b) the frequency of teaching their child pinyin, and (c) the frequency of teaching their child to write Chinese characters.

Table 1 Descriptive statistics on the questions included in the parents' questionnaire

Question	<i>M</i>	<i>SD</i>	Min	Max
1. What is the highest level of education attained by the child's mother?	4.89	1.17	1	7
2. What is the highest level of education attained by the child's father?	5.16	1.11	2	7
3. What is family's monthly income?	4.98	1.51	1	10
4. How many times in a typical week do you read a bedtime story/stories to your child?	3.93	2.14	0	7
5. How many times in a typical week do you read a story or stories with your child at other times?	2.47	1.85	0	7
6. How many children's books do you have at home?	3.92	1.56	1	7
7. How many times in a typical week do you visit a library?	2.81	.91	1	5
8. How many times in a typical week do you teach your child to read characters?	3.21	.97	1	5
9. How many times in a typical week do you teach your child to write characters?	2.54	.88	1	5
10. How many times in a typical week do you teach your child to read pinyin?	2.76	1.16	1	5
11. How well do you think your child will be doing in reading next year (Grade 1)?	2.66	.96	0	4
12. How well do you think your child will be doing in writing next year (Grade 1)?	2.51	.98	0	4
13. Diary_Average Time (Weekdays)	3.90	2.57	0	10
14. Diary_Average Time (Weekend)	1.79	1.21	0	5

Informal home literacy experiences (IHLE)

To assess IHLE we first asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = very often) (a) the frequency of reading a story to their child at bedtime and (b) the frequency of reading a story to their child at other times. Second, we asked parents to keep a diary with their daily shared book reading activity with their child (see Authors, 2018, for details). This form of collecting daily information on shared book reading was adopted from the work of Anderson, Wilson, and Fielding (1988) and Allen, Cipelewski, and Stanovich (1992). We awarded one point for every 30-minute time period recorded. A composite score for daily shared book reading activity was calculated by averaging z -scores for the scores for weekdays and weekends and used in the analyses.

Access to literacy resources (ALR)

To assess ALR, we first asked parents to report how many children's books they had at home. The reported number was subsequently recoded on a 7-point scale (1 = none, 2 = 1–20, 3 = 21–40, 4 = 41–60, 5 = 61–80, 6 = 81–100, and 7 = more than 100 books). Second, we asked parents to indicate by using a 5-point Likert scale (1 = never to 5 = very often) the frequency of visiting with their child libraries or bookstores.

Family's socioeconomic status (SES)

We asked parents to indicate their highest achieved educational level among seven options ranging from third grade or less to completed graduate studies. In addition, we asked parents to indicate the family's monthly income. For this question, we provided parents 10 options ranging from less than 3000 Chinese yuan (RMB) per month to more than 28,000 RMB per month. A composite score of family's SES was calculated by averaging the z -scores of parents' education (average score for mother's and father's education) and family's income.

Parents' expectations

We asked parents to report on their expectations about their child's future reading and writing ability using two 5-point Likert-scale questions: When your child goes to Grade 1, how well do you think s/he will be doing (a) in reading and (b) in writing. The Likert scale ranged from very poorly to very well.

Rapid automatized naming (RAN)

Digit Naming from the Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 1999) was administered to assess RAN. Children were asked to name as fast as possible six recurring Arabic numerals (2, 3, 4, 5, 7, 8; pronounced er[4], san[1], si[4], wu[3], qi[1], and ba[1]; the number in brackets indicates the tone) that were repeated six times each and arranged in semi random order

in four rows of nine. Prior to testing, the children were asked to name the digits in a practice trial to ensure familiarity. A child's score was the total time to name all stimuli. Test–retest reliability with a subsample of children in our study ($n = 20$) was .86.

Phonological awareness

Syllable Deletion from Li, Shu, McBride-Chang, Liu, and Peng (2012) was administered to assess phonological awareness. Children were asked to say what was left in a two- or three-syllable Chinese word after deleting one of the syllables (e.g., Say/hong 2 tai 4 yang2/'red sun'. Now say/hong 2 tai 4 yang 2/without/hong2/would be/tai 2 yang 2/'sun'). The task consisted of eight two-syllable items and 12 three-syllable items. Half of the two-syllable items required deleting the first syllable and the other half the last syllable, while in the three-syllable items, one-third of the items required deleting the first, one third the middle, and one third the final syllable, respectively. A child's score was the total number correct and a discontinuation rule of five consecutive errors was applied. Cronbach's alpha reliability in our sample was .85.

Vocabulary

Word Definitions from Chow, McBride-Chang, and Burgess (2005) was administered to assess vocabulary. Children were asked to define a word that was provided by the tester. Scoring was based on the number of important semantic features included, following the scoring scheme in the test manual. One point was given for each feature with a maximum score of 2 for each item. The task consisted of two practice items and 32 test items arranged in increasing difficulty, resulting in a total score of 64. Testing was discontinued after five consecutive errors. Cronbach's alpha reliability in our sample was .84.

Pinyin knowledge

Pinyin knowledge was assessed with the pinyin letter and syllable knowledge task from Li et al. (2017). Children were asked to read 60 pinyin items (23 consonants [*b, p, m, f, d, t, n, l, g, k, h, j, q, x, z, c, s, zh, ch, sh, r, y, w*], 24 vowels [*a, o, e, i, u, ü, ai, ei, ui, ao, ou, iu, i.e., ue, er, an, en, in, un, ün, ang, eng, ing, ong*], and 13 syllables [*zi, ci, si, zhi, chi, shi, ri, ye, yin, yue, yun, yuan, ying*]) that were arranged in increasing difficulty. The test was discontinued after six consecutive errors and a child's score was the total number correct (max = 60). Cronbach's alpha reliability in our sample was .82.

Word reading

Character Recognition from Li et al. (2012) was used to assess word reading ability. Children were asked to read aloud Chinese characters arranged in terms of increasing difficulty. The task consisted of 150 characters (e.g., 包, 灯, 害; see Li et al., 2012, for details on how the task was constructed) and it was discontinued after six consecutive errors. A child's score was the total number correct (max = 150). Cronbach's alpha reliability in our sample was .94.

Reading comprehension

To assess reading comprehension, we administered two measures: Sentence-Picture Matching (SPM) and Sentence Verification (SV). SPM was adopted from Desrochers (2018) and required children to silently read a sentence that was printed in the middle of a page and then select which one of the four pictures printed beneath the sentence portrayed the meaning of the sentence. Children were given a minute to match as many sentences as possible (max = 22). The test is similar to the reading comprehension test from Peabody Individual Achievement Test (Dunn & Markwardt, 1970). Test-retest reliability with a subsample of our participants ($n=20$) was .84. In addition, SPM correlated .75 with SV in our sample.

In SV, children were asked to silently read simple sentences (e.g., *Planes can fly*) and circle Y (Yes) if the meaning of the sentence was true or N (No) if the meaning of the sentence was false. The Y and N were printed at the end of each sentence. Children were given three minutes to read as many of the 60 sentences as possible and their score was calculated by subtracting the number of incorrect responses from the number of correct. The test was constructed following the principles of the Test of Silent Reading Efficiency and Comprehension (Wagner, Torgesen, Rashotte, & Pearson, 2010), which has been found to correlate strongly with other measures of reading comprehension (e.g., Ahmed, Wagner, & Lopez, 2014; Kang & Shin, 2019; Kim, Wagner, & Foster, 2011) and to load on the same factor as other comprehension measures (e.g., Lonigan & Burgess, 2017). Test-retest reliability with a subsample of our participants ($n=20$) was .90.

Procedure

The children were assessed towards the end of the third kindergarten year (Time 1: April), at the beginning of Grade 1 (Time 2: October), and at the middle of Grade 2 (Time 3: January). In kindergarten, we administered measures of RAN, phonological awareness, pinyin knowledge, and vocabulary. In Grade 1, we tested children's word reading. Finally, in Grade 2, we administered the two measures of reading

comprehension. Children were individually tested in their school by the first author and the testing lasted approximately 30 min in kindergarten, 15 min in Grade 1, and 10 min in Grade 2. For the purpose of calculating the test–retest reliability for the speeded measures in our sample, we randomly selected a subsample of our participants ($n=20$) and reassessed them on the same measures three weeks after the initial testing.

Statistical analysis

To examine the relations between the HLE aspects and the reading outcomes, we performed structural equation modeling with Mplus 8 (Muthén & Muthén, 1998–2017). First, a longitudinal structural model was constructed (Fig. 1).³ Guided by the home literacy model (Sénéchal, 2006; Sénéchal & LeFevre, 2002) and the previous findings on HLE in Chinese, we expected that family's SES and parents' expectations would predict all three HLE aspects. In turn, we allowed the three HLE aspects to predict the four emergent literacy skills (Word Definitions, Syllable Deletion, Pinyin Knowledge, and RAN Digits). Finally, we allowed all emergent literacy skills to predict word reading in Grade 1 and word reading to predict reading comprehension in Grade 2. Nonsignificant paths were eliminated one at a time in order to evaluate a more parsimonious model with fewer paths.

Missing data were handled by the full information maximum likelihood estimator in Mplus (Muthén & Muthén, 1998–2017). Model fits were assessed using the Chi square value and four commonly applied descriptive goodness-of-fit indices: the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). A nonsignificant Chi square value, CFI and TLI values above .95, and RMSEA and SRMR values below .08 indicate good model fit (Brown & Cudeck, 1993; Hu & Bentler, 1999; Kline, 2015).

Second, to examine the indirect effects of family's SES, parents' expectations, and HLE aspects on later reading skills we conducted a mediation analysis (Hayes, 2013; MacKinnon, Fairchild, & Fritz, 2007). We utilized the Model Indirect command in Mplus to calculate a standardized indirect effect estimate and used a bias-corrected bootstrapping technique, which is robust to potential deviations from multivariate normality (Hayes & Scharkow, 2013), with 2000 resamples that allowed us to establish confidence intervals (CIs) for the indirect effects. The CIs can be used as a test of whether an indirect effect differs from zero, that is, whether the inclusion of a specific mediator significantly reduces the effects of HLE aspects on word reading. If the bootstrapped CIs do not include zero, there is a 95% probability that the effects are significant (Preacher & Hayes, 2008; Shrout & Bolger, 2002).

³ Before constructing the structural model, we tested a measurement model for the home literacy environment and confirmed that the five constructs (parents' expectations, family's SES, FHLE, IHLE, and ALR) were properly assessed with the questionnaire used in this study. The results of this analysis can be obtained from the corresponding author.

Results

Preliminary data analysis

The descriptive statistics for the parents' measures are shown in Table 1 and for the children's measures in Table 2. Before conducting any further analyses, we calculated intra-class correlations because the children were nested within classrooms. The correlations ranged from .03 to .06, suggesting that the performance of the children on the emergent literacy and the reading outcomes was not influenced by their class membership. Next, we checked the distributional properties of the measures. Pinyin knowledge in kindergarten and word reading in Grade 1 were positively skewed, and a log transformation was used to normalize their distribution (Tabachnick & Fidell, 2012). In addition, a few outliers in some measures (scores more than 3 *SDs* above/below the mean of the whole sample) were moved to the tails of the distributions to avoid overemphasizing their effects on the results. All the variables were standardized before further analyses.

The zero-order correlations among all the variables are shown in Table 3. With the exception of a strong correlation between the frequency of teaching pinyin and children's pinyin knowledge ($r = .59$), the rest of the correlations between the items of the HLE aspects and the emergent literacy skills/reading outcomes were relatively weak. The size of these correlations is similar to that reported in previous studies on HLE (e.g., Liu et al., 2018; Manolitsis et al., 2013; Silinskas et al., 2012; Stephenson, Parrila, Georgiou, & Kirby, 2008).

Structural model for home literacy environment and reading outcomes

The structural model for home literacy environment, emergent literacy skills, and reading outcomes is shown in Fig. 1. The model fit the data very well, $\chi^2(140) = 139.55$, $p = .49$, CFI = 1.00, TLI = 1.00, RMSEA = .00, 90%CI [.00, .04], SRMR = .06. Parents' expectations predicted FHLE, IHLE, and ALR ($\beta_s = .22-.57$), after controlling for family's SES. FHLE predicted pinyin knowledge in kindergarten ($\beta = .29$), which, in turn, predicted word reading in Grade 1 ($\beta = .28$). The more frequently parents taught Chinese characters and pinyin to their children, the better

Table 2 Descriptive statistics for the children's measures used in the study

Measure	<i>M</i>	<i>SD</i>	Min	Max
<i>Kindergarten</i>				
Syllable deletion	10.55	5.16	0	20
RAN-digits ^a	23.63	5.92	10.82	39.86
Word definitions	15.26	7.39	0	33
Pinyin knowledge	8.11	10.30	0	29
<i>Grade 1</i>				
Word reading	15.81	22.03	0	80
<i>Grade 2</i>				
Sentence-picture matching	7.98	2.51	3	14
Sentence verification	23.92	8.32	7	48

^aMeasured in seconds

Table 3 Correlations among the observed variables

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1. Mother's education																			
2. Father's education	.68**																		
3. Family's income	.46**	.52**																	
4. Read to child at bedtime	.34**	.20*	.24**																
5. Read to child at other times	.07	.16*	.11	.41**															
6. Parents' diary	.24**	.29**	.17*	.60**	.48**														
7. Teach to read characters	.29**	.28**	.12	.18*	.25**	.21*													
8. Teach to write characters	.48**	.37**	.00	.15	.23**	.09	.51**												
9. Teach to read pinyin	.10	.25**	.06	.02	.20*	.04	.45**	.56**											
10. Parents' expectation for reading	-.12	.12	.16*	.27**	.19*	.14	.22**	.17*	.23**										
11. Parents' expectation for writing	.01	.14	.15	.10	.21*	.14	.17*	.36**	.35**	.64**									
12. Number of children's books	.48**	.37**	.29**	.37**	.18*	.22**	.25**	.04	.07	.29**	.29**								
13. Visits to libraries/bookstores	.29**	.28**	.26**	.39**	.29**	.33**	.25**	.15	.13	.33**	.16*	.39**							

Table 3 (continued)

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
14. Syllable Deletion_K	.17*	.19*	.11	.21*	.15	.11	.19*	.06	.04	.45**	.23**	.32**	.21*						
15. RAN-Digits_K	-.21*	-.23**	-.18*	-.22**	-.15	-.12	-.27**	-.12	-.15	-.32**	-.14	-.27**	-.20*	-.53**					
16. Word Definitions_K	.32**	.23**	.20*	.17*	.14	.19	.02	-.03	.02	.39**	.21*	.11	.20*	.43**	-.28**				
17. Pinyin Knowledge_K	.14	.18*	.11	.09	.19*	.07	.32**	.30**	.59**	.30**	.29**	.18*	.17*	.30**	-.36**	.06			
18. Word Reading_G1	.29**	.28**	.05	.17*	.19*	.11	.37**	.14	.15	.47**	.20*	.27**	.24**	.63**	-.51**	.27**	.48**		
19. Sentence-Picture Matching_G2	.15	.15	.11	.15	.08	.02	.20*	.06	.17*	.40**	.17*	.24**	.19*	.57**	-.52**	.39**	.32**	.64**	
20. Sentence Verification_G2	.17*	.20*	.19*	.19*	.11	.08	.03	.23**	.09	.18*	.43**	.21*	.29**	.16*	-.55**	.42**	.37**	.67**	.75**

RAN rapid automatized naming, K kindergarten, G1 Grade 1, G2 Grade 2

* $p < .05$; ** $p < .01$

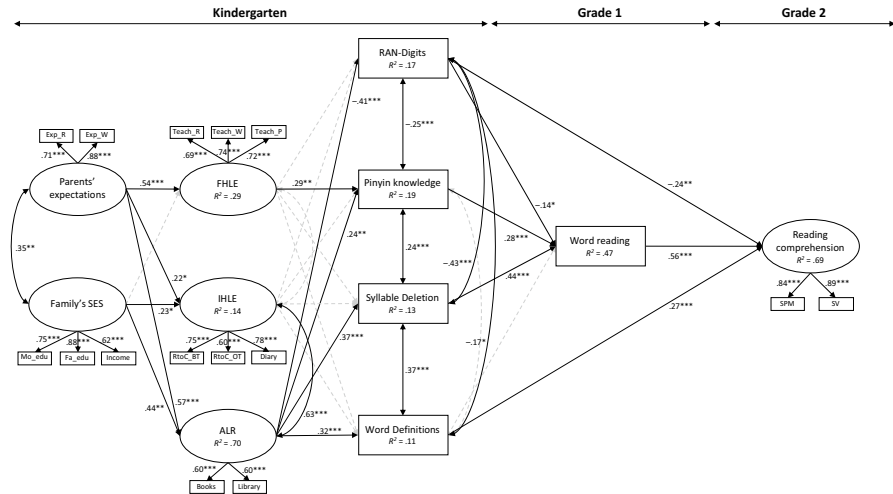


Fig. 1 The final model for the associations between home literacy environment, cognitive skills in kindergarten, and reading skills in Grade 1. Solid lines represent significant paths and dashed lines represent nonsignificant paths. To simplify presentation, error covariances between the indicators of latent variables are not shown. *Mo_edu* mother’s education, *Fa_edu* father’s education, *Exp_R* parents’ expectation for reading, *Exp_W* parents’ expectation for writing, *Teach_R* teaching reading characters, *Teach_W* teaching writing characters, *Teach_P* teaching pinyin, *RtoC_BT* reading to child at bedtime, *RtoC_OT* reading to child at other times, *FHLE* formal home literacy experiences, *IHLE* informal home literacy experiences, *ALR* access to literacy resources, *RAN* rapid automatized naming, *SPM* Sentence-Picture Matching, *SV* Sentence Verification. * $p < .05$. ** $p < .01$. *** $p < .001$

their children’s pinyin knowledge and word reading were. ALR also predicted all four emergent literacy skills (β s = .24–.41 in absolute values). The greater access to literacy resources parents reported, the better their children’s scores in the four emergent literacy skills were. In contrast, IHLE did not uniquely predict any of the emergent literacy skills. RAN-Digits predicted word reading in Grade 1 ($\beta = -.14$) and reading comprehension in Grade 2 ($\beta = -.24$). Syllable Deletion predicted word reading in Grade 1 ($\beta = .44$). Finally, Word Definitions uniquely predicted reading comprehension in Grade 2 ($\beta = .27$) over and above the effects of word reading.

Mediation analysis

Finally, we estimated the total indirect effects of parents’ expectations, family’s SES, FHLE, and ALR on later reading skills (word reading and reading comprehension) via early emergent literacy skills. Standardized estimates of the total indirect effects and their CIs are shown in Table 4. The results indicated that parents’ expectations, family’s SES, FHLE, and ALR in kindergarten all had significant indirect effects on both word reading in Grade 1 (estimates = .08–.29) and reading comprehension in Grade 2 (estimates = .04–.35) via the emergent literacy skills in kindergarten. In contrast, IHLE did not have a significant indirect effect on any reading outcomes when the effects of the other variables were taken into account. Among all the

Table 4 Total indirect effects of the home literacy environment on later reading skills

Total indirect effect	Estimate (<i>SE</i>)	<i>p</i>	95% CI
<i>Word reading in Grade 1</i>			
Parents' expectations	.21 (.05)	<.001	[.12, .32]
Family's SES	.13 (.04)	.001	[.06, .21]
FHLE	.08 (.03)	.015	[.02, .15]
IHLE	-.01 (.06)	.886	[-.12, .11]
ALR	.29 (.08)	.001	[.12, .44]
<i>Reading comprehension in Grade 2</i>			
Parents' expectations	.22 (.05)	<.001	[.13, .33]
Family's SES	.15 (.04)	<.001	[.07, .24]
FHLE	.05 (.02)	.024	[.01, .09]
IHLE	-.01 (.03)	.890	[-.07, .06]
ALR	.35 (.07)	<.001	[.20, .48]

CI confidence interval, *SES* socioeconomic status, *FHLE* formal home literacy experiences, *IHLE* informal home literacy experiences, *ALR* access to literacy resources

predictor variables, ALR had the strongest effects on later reading outcomes (see Table 4).

Discussion

The purpose of this study was to examine how home literacy environment predicts Chinese reading in a sample of children followed from kindergarten to Grade 2. First, our results showed that formal literacy experiences predicted pinyin knowledge and through the effects of pinyin knowledge word reading and reading comprehension. Being a phonetic transcription system, pinyin likely sensitizes children both to segmental and suprasegmental information (i.e., tones). This is very helpful in learning to read Chinese because by looking at the characters alone, one gets minimal information about their pronunciation. Thus, parents who teach pinyin to their kindergarten children better prepare them for learning Chinese characters in Grade 1, which, in turn, provides the basis of reading comprehension.

Second, we found that informal literacy experiences did not predict any emergent literacy skill or reading. This is in contrast to the premises of the home literacy model, but in line with the findings of some previous studies in Western countries (e.g., Evans et al., 2000; Silinskas et al., 2012; Stephenson et al., 2008) and China (Deng et al., 2015; Li et al., 2008; Liu et al., 2018). There might be three explanations for this finding. First, it may be due to social desirability bias (see Liu et al., 2018; Manolitsis et al., 2013, for a similar argument). As pointed out by Sénéchal et al. (1998), asking parents about the frequency of shared book reading is sensitive to social desirability, and as such it may reflect parents' intentions rather than actions. Second, it may be due to our decision to exclude 'number of children's

books at home' from the informal literacy experiences factor. Although 'number of children's books at home' is frequently used as an indicator of informal literacy experiences (e.g., Inoue et al., 2018; Sénéchal, 2006), it is not an activity parents carry out with their children at home. At the same time, previous studies have shown that 'frequency of shared book reading' itself may not be significantly related to emergent literacy skills (e.g., Liu et al., 2018; Sénéchal, 2006; Sénéchal et al., 1998). This suggests that excluding 'number of children's books at home' from the informal literacy experiences factor may also eliminate the possible effects of this factor on children's reading skills. Finally, because informal literacy experiences correlated strongly with access to literacy resources in our sample ($r = .67$, see Fig. 1), it is possible that their effect on reading skills might have been masked by the strong effect of access to literacy resources.

Finally, we found that access to literacy resources predicted all emergent literacy skills and through their effect word reading and reading comprehension. Although previous studies in Chinese have shown that 'number of children's books at home' (one of the indicators of the access to literacy resources factor in our study) correlates significantly with vocabulary (e.g., Lau & McBride-Chang, 2005; Liu et al., 2018) and phonological awareness (e.g., Ruan et al., 2006; Su et al., 2017), to our knowledge, this is the first time access to literacy resources has been found to predict RAN and pinyin knowledge. By providing more printed materials at home and visiting libraries/bookstores more frequently, parents may increase their children's opportunities to interact with written symbols (e.g., letters, digits) and this, in turn, can enhance their child's autonomy in accessing written materials as well as some active interest in learning these written symbols. Ruan et al. (2006), for example, have shown that literacy resources at home predicted the informal literacy experiences, which then predicted phonological awareness. Taken together, these findings suggest that there might be value in revising the home literacy model so that 'number of children's books at home' is separated from the 'informal literacy experiences' component and becomes part of a broader 'access to literacy resources' component.

Parents' expectations of their children's academic achievement during kindergarten were closely associated with home literacy environment and had a long-lasting association with reading outcomes, even after controlling for the effects of family's SES. Given the cultural context of China where parents tend to pay particular attention to their children's academic achievement (e.g., Lu, 1999; Zhu & Yang, 2003), our finding suggests that we should inform parents, particularly those from lower SES backgrounds, that their expectations can indeed have a positive effect on their children's reading development.

The fact that parents' expectations influenced word reading and reading comprehension more than family's SES in our study may be due to the period covered in our study. Because reading readiness is thought to be very important for 6-year old Chinese children, parents with higher expectations may engage in more direct and indirect activities related to their children's reading and writing. Especially, since pinyin teaching starts right from the beginning of Grade 1, parents with higher expectations will teach pinyin during kindergarten to allow their children a head start in reading.

Some limitations of the present study are worth mentioning. First, our study was correlational and any significant effects do not imply causation. Second, our sample

size was relatively small ($N=159$) and for this reason we ask that our findings are interpreted with some caution. Third, because there are no standardized measures of reading comprehension in mainland China, we used two measures that also exist in English and were deemed by a group of 10 Grade 2 teachers in Jining to be appropriate to assess second graders' comprehension. We acknowledge though that different measures of comprehension may elicit different effects from cognitive and non-cognitive factors (e.g., Kendeou, Papadopoulos, & Spanoudis, 2012). Fourth, the children in our sample were attending third year kindergarten which means that their parents had opportunities to discuss their performance with the kindergarten teachers in the previous two years. Assuming parents take teachers' feedback into account and modify their level of engagement and instruction accordingly (Manolitsis et al., 2011), the frequency of different home literacy activities in our study may be somewhat higher than what we would observe in studies in Western countries where children typically attend kindergarten for a year and their parents do not have the same level of feedback. Finally, access to literacy resources may depend on parents' availability, which we did not assess. In other words, busier parents will not likely have time to take their children to libraries/bookstores. Parents' availability should be assessed in a future study.

To conclude, our findings reinforce those of previous studies in Western countries (e.g., Inoue et al., 2018; Manolitsis et al., 2011; Sénéchal, 2006; Skwarchuk et al., 2014) suggesting that HLE influences reading through multiple pathways. However, these pathways may differ slightly from those reported in studies in Western countries. In Chinese, what matters most seems to be how readily available and accessible different literacy resources are rather than the frequency of shared book reading at home. Access to literacy resources predicted all emergent literacy skills and subsequently word reading and reading comprehension. Formal literacy experiences also exerted a small effect on reading through the effects of pinyin knowledge. An HLE model in Chinese must include pinyin that is introduced by parents in kindergarten (e.g., McBride-Chang et al., 2012) to bridge the gap between phonology and orthography in Chinese. Finally, informal literacy experiences do not seem to play an important role in Chinese reading (at least when access to literacy resources is included as a separate factor in the model). A future study should explore these relations across multiple sites in China as well as across cultures.

References

- Ahmed, Y., Wagner, R. K., & Lopez, D. (2014). Developmental relations between reading and writing at the word, sentence and text levels: A latent change score analysis. *Journal of Educational Psychology*, *106*, 419–434. <https://doi.org/10.1037/a0035692>.
- Allen, L., Cipielewski, J., & Stanovich, K. E. (1992). Multiple indicators of children's reading habits and attitudes: Construct validity and cognitive correlates. *Journal of Educational Psychology*, *84*, 489–503.
- Anderson, R. C., Wilson, P. T., & Fielding, L. G. (1988). Growth in reading and how children spend their time outside of school. *Reading Research Quarterly*, *23*, 285–303.
- Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). New York, NY: Greenwood Press.

- Britto, P. R., & Brooks-Gunn, J. (2001). Beyond shared book reading: Dimensions of home literacy and low-income African American preschoolers skills. *New Directions for Child and Adolescent Development*, 92, 73–90.
- Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA: Harvard University Press.
- Browne, M. W., & Cudeck, R. (1993). Alternative ways in assessing model fit. In K. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.
- Chiu, M. M., & McBride-Chang, C. (2006). Gender, context, and reading: A comparison of students in 43 countries. *Scientific Studies of Reading*, 10, 331–362.
- Chow, B. W. Y., McBride-Chang, C., & Burgess, S. (2005). Phonological processing skills and early reading abilities in Hong Kong Chinese kindergartners learning to read English as a second language. *Journal of Educational Psychology*, 97, 81–87.
- Curry, J. E. (2012). *Development and validation of a home literacy questionnaire to assess emergent reading skills of pre-school children (Unpublished doctoral dissertation)*. Edmonton, Canada: University of Alberta.
- Deng, C. P., Silinskas, G., Wei, W., & Georgiou, G. K. (2015). Cross-lagged relationships between home learning environment and academic achievement in Chinese. *Early Childhood Research Quarterly*, 33, 12–20.
- Desrochers, A. (2018). *Sentence-picture matching task for reading comprehension assessment*. Ottawa: University of Ottawa.
- Dunn, L. M., & Markwardt, F. C. (1970). *Examiner's manual: Peabody individual achievement test*. Circle Pines, MN: American Guidance Service.
- Esmaeeli, Z., Kyle, F. E., & Lundstræ, K. (2019). Contribution of family risk, emergent literacy and environmental protective factors in children's reading difficulties at the end of second-grade. *Reading and Writing*, 32, 2375–2399. <https://doi.org/10.1007/s11145-019-09948-5>
- Evans, M. A., Fox, M., Cremaso, L., & Mckinnon, L. (2004). Beginning reading: The views of parents and teachers of young children. *Journal of Educational Psychology*, 96, 130–141.
- Evans, M.A., & Koblinsky, B. (2017). Home literacy environment from junior to senior kindergarten and relation to parent values. In *Paper presented at the 24th annual conference of the Society for the Scientific Studies of Reading*, Halifax, Canada.
- Evans, M. A., Shaw, D., & Bell, M. (2000). Home literacy activities and their influence on early literacy skills. *Canadian Journal of Experimental Psychology*, 54, 65–75.
- Family Education Study Centre (2012). *Whose responsibility is it to teach different subject areas to children? A survey*. Retrieved on December 15, 2017 from http://m.sohu.com/n/344118262/?page=1&_smsid=UOnUrCuyInooQpMCnAVBT6
- Froiland, J. M., Peterson, A., & Davison, M. L. (2013). The long-term effects of early parent involvement and parent expectation in the USA. *School Psychology International*, 34, 33–50.
- Hamilton, L. G., Hayiou-Thomas, M. E., Hulme, C., & Snowling, M. (2016). The home literacy environment as a predictor of the early literacy development of children at family-risk of dyslexia. *Scientific Studies of Reading*, 20, 401–419.
- Hartas, D. (2011). Families' social backgrounds matter: Socio-economic factors, home learning and young children's language, literacy and social outcomes. *British Educational Research Journal*, 37, 893–914.
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.
- Hayes, A. F., & Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis. *Psychological Science*, 24, 1918–1927. <https://doi.org/10.1177/0956797613480187>.
- Hood, M., Conlon, E., & Andrews, G. (2008). Preschool home literacy practices and children's literacy development: A longitudinal analysis. *Journal of Educational Psychology*, 100, 252–271.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55. <https://doi.org/10.1080/10705519909540118>.
- Inoue, T., Georgiou, G., Parrila, R., & Kirby, R. J. (2018). Examining an extended home literacy model: The mediating roles of emergent literacy skills and reading fluency. *Scientific Studies of Reading*, 22, 273–288.
- Institute of Linguistics, Chinese Academy of Social Sciences. (2004). *新华字典(第10版)*. [Xinhua dictionary (10th ed.)]. Beijing, China: Commercial Press.


- Ip, P., Rao, N., Bacon-Shone, J., Li, S. L., Ho, F. K., Chow, C., et al. (2016). Socioeconomic gradients in school readiness of Chinese preschool children: The mediating role of family processes and kindergarten quality. *Early Childhood Research Quarterly*, *35*, 111–123.
- Jining Municipal Bureau of Statistics. (2017). *Jining statistical yearbook*. Retrieved on March. 23, 2019 from: http://tjj.jining.gov.cn/art/2018/10/29/art_6793_815244.html
- Kang, E. Y., & Shin, M. (2019). The contributions of reading fluency and decoding to reading comprehension for struggling readers in fourth grade. *Reading and Writing Quarterly*. <https://doi.org/10.1080/10573569.2018.1521758>.
- Kendeou, P., Papadopoulos, T. C., & Spanoudis, G. (2012). Processing demands of reading comprehension tests in young readers. *Learning and Instruction*, *22*, 354–367.
- Kim, Y.-S., Wagner, R. K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Scientific Studies of Reading*, *15*, 338–362.
- Kirby, J. R., & Hogan, B. (2008). Family literacy environment and early literacy development. *Exceptionality Education International*, *18*, 112–130.
- Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). New York, NY: Guilford Press.
- Lau, J. Y.-H., & McBride-Chang, C. (2005). Home literacy and Chinese reading in Hong Kong children. *Early Education and Development*, *16*, 5–22.
- Li, H., Corrie, L. F., & Wong, B. K. M. (2008). Early teaching of Chinese literacy skills and later literacy outcomes. *Early Child Development and Care*, *178*, 448–459.
- Li, Y., Li, H., De, X., Sheng, X., Richardson, U., & Lyytinen, H. (2017). 游戏化学习促进学生个性化发展的实证研究—以GraphoGame拼音游戏为例. [An evidence-based research on facilitating students' development of individualize learning by game-based learning —Pinyin GraphoGame as an example]. *China Educational Technology*, *364*, 95–101.
- Li, H., & Rao, N. (2000). Parental influences on Chinese literacy development: A comparison of preschoolers in Beijing, Hong Kong, and Singapore. *International Journal of Behavioral Development*, *24*, 82–90.
- Li, H., Shu, H., McBride-Chang, C., Liu, H., & Peng, H. (2012). Chinese children's character recognition: Visuo-orthographic, phonological processing and morphological skills. *Journal of Research in Reading*, *35*, 287–307.
- Liu, C., Georgiou, G. K., & Manolitsis, G. (2018). Modeling the relationships of parents' expectations, family's SES, and home literacy environment with emergent literacy skills and word reading in Chinese. *Early Childhood Research Quarterly*, *43*, 1–10.
- Liu, J., Peng, P., & Luo, L. (2019). The relation between family socioeconomic status and academic achievement in China. *Educational Psychology Review*. <https://doi.org/10.1007/s10648-019-09494-0>.
- Lonigan, C. J., & Burgess, S. R. (2017). Dimensionality of reading skills with elementary-school-age children. *Scientific Studies of Reading*, *21*, 239–253.
- Lu, Y. (1999). Nice family atmosphere is the precondition and basis of education. *Family Education*, *147*, 1–12. [in Chinese].
- MacKinnon, D. P., Fairchild, A. J., & Fritz, M. S. (2007). Mediation analysis. *Annual Review of Psychology*, *58*, 593–614. <https://doi.org/10.1146/annurev.psych.58.110405.085542>.
- Manolitsis, G., Georgiou, G., & Parrila, R. (2011). Revisiting the home literacy model of reading development in an orthographically consistent language. *Learning and Instruction*, *21*, 496–505.
- Manolitsis, G., Georgiou, G., & Tziraki, N. (2013). Examining the effects of home literacy and numeracy environment on early reading and mathematics acquisition. *Early Childhood Research Quarterly*, *28*, 692–703.
- Martini, F., & Sénéchal, M. (2012). Learning literacy skills at home: Parent teaching, expectations, and child interest. *Canadian Journal of Behavioural Science*, *44*, 210–221.
- McBride, C. (2015). *Children's literacy development: A cross-cultural perspective on learning to read and write*. London, UK: Routledge.
- McBride-Chang, C., Lin, D., Liu, P. D., Aram, D., Levin, I., Cho, J.-R., et al. (2012). The ABC's of Chinese: Maternal mediation of Pinyin for Chinese children's early literacy skills. *Reading and Writing: An interdisciplinary Journal*, *25*, 283–300.
- Ministry of Education of the People's Republic of China. (2012). *The Chinese curriculum standards in compulsory education*. Beijing, China: Beijing Normal University Publishing Group.

- Muthén, L.K., & Muthén, B.O. (1998–2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Muthén & Muthén.
- Netten, A., Droop, M., & Verhoeven, L. (2011). Predictors of reading literacy for first and second language learners. *Reading and Writing: An Interdisciplinary Journal*, *24*, 413–425. <https://doi.org/10.1007/s11145-010-9234-2>.
- Niklas, F., & Schneider, W. (2013). Home literacy environment and the beginning of reading and spelling. *Contemporary Educational Psychology*, *38*, 40–50.
- Payne, A. C., Whitehurst, G., & Angell, A. L. (1994). The role of home literacy environment in the development of language ability in preschool children from low-income families. *Early Childhood Research Quarterly*, *9*, 427–440. [https://doi.org/10.1016/0885-2006\(94\)90018-3](https://doi.org/10.1016/0885-2006(94)90018-3).
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891. <https://doi.org/10.3758/BRM.40.3.879>.
- Roth, F. P., Speece, D., & Cooper, D. H. (2002). A longitudinal analysis of the connection between oral language and early reading. *Journal of Educational Research*, *95*, 259–272.
- Ruan, F.-J., Zhou, H., & Li, L. (2006). 家庭读写环境对幼儿语音意识的作用. [The role of home literacy in children's phonological awareness.]. *Psychological Development and Education*, *1*, 13–17.
- Sénéchal, M. (2006). Testing the Home Literacy Model: Parent involvement in kindergarten is differentially related to grade 4 reading comprehension, fluency, spelling, and reading for pleasure. *Scientific Studies of Reading*, *10*, 59–87. https://doi.org/10.1207/s1532799xssr1001_4.
- Sénéchal, M., & LeFevre, J. A. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development*, *73*, 445–460.
- Sénéchal, M., & LeFevre, J. (2014). Continuity and change in the home literacy environment as predictors of growth in vocabulary and reading. *Child Development*, *85*, 1552–1568. <https://doi.org/10.1111/cdev.12222>.
- Sénéchal, M., LeFevre, J., Thomas, E. M., & Daley, K. E. (1998). Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly*, *33*, 96–116.
- Sénéchal, M., Whissell, J., & Bildfell, A. (2017). Starting from home: Home literacy practices that make a difference. In K. Cain, D. L. Compton, & R. K. Parrila (Eds.), *Theories of Reading Development* (pp. 383–407). Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, *7*, 422–445. <https://doi.org/10.1037//1082-989X.7.4.422>.
- Shu, H. (2003). Chinese writing system and learning to read. *International Journal of Psychology*, *38*, 274–285. <https://doi.org/10.1080/00207590344000060>.
- Shu, H., Li, W., Anderson, R. C., Ku, Y.-M., & Yue, X. (2002). The role of home-literacy environment in learning to read Chinese. In W. Li, J. S. Gaffney, & J. L. Packard (Eds.), *Chinese children's reading acquisition: Theoretical and pedagogical issues* (pp. 207–224). Boston, MA: Kluwer Academic Publishers.
- Silinskas, G., Kiuru, N., Tolvanen, A., Niemi, P., Lerkkanen, M.-K., & Nurmi, J.-E. (2013). Maternal teaching of reading and children's reading skills in grade 1: Patterns and predictors of positive and negative associations. *Learning and Individual Differences*, *27*, 54–66. <https://doi.org/10.1016/j.lindif.2013.06.011>.
- Silinskas, G., Lerkkanen, M. K., Tolvanen, A., Niemi, P., Poikkeus, A.-M., & Nurmi, J.-E. (2012). The frequency of parents' reading-related activities at home and children's reading skills during kindergarten and Grade 1. *Journal of Applied Developmental Psychology*, *33*, 302–310. <https://doi.org/10.1016/j.appdev.2012.07.004>.
- Silinskas, G., Torppa, M., Lerkkanen, M.-K., & Nurmi, J.-E. (2019). The home literacy model in a highly transparent orthography. *School Effectiveness and School Improvement*. Advance online publication. <https://doi.org/10.1080/09243453.2019.1642213>
- Skwarchuk, S. L., Sowinski, C., & LeFevre, J. (2014). Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model. *Journal of Experimental Child Psychology*, *121*, 63–84.
- Stephenson, K. A., Parrila, R., Georgiou, G. K., & Kirby, J. R. (2008). Effects of home literacy, parents' beliefs, and children's task-focused behaviour on emergent literacy and word reading skills. *Scientific Studies of Reading*, *12*, 24–50.

- Stevenson, H. W., & Stigler, J. (1992). *The learning gap: Why our schools are failing and what can we learn from Japanese and Chinese education*. New York, NY: Summit Books.
- Su, M., Peyre, H., Song, S., McBride, C., Tardif, T., Li, H., et al. (2017). The influence of early linguistic skills and family factors on literacy acquisition in Chinese children: Follow-up from age 3 to age 11. *Learning and Instruction, 49*, 54–63.
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.
- Torppa, M., Poikkeus, A.-M., Laakso, M.-L., Tolvanen, A., Leskinen, E., Leppänen, P. H. T., et al. (2007). Modeling the early paths of phonological awareness and factors supporting its development in children with and without familial risk of dyslexia. *Scientific Studies of Reading, 11*, 73–103.
- Umek, L. M., Podlesek, A., & Fekonja, U. (2005). Assessing the home literacy environment: Relationships to child language comprehension and expression. *European Journal of Psychological Assessment, 21*, 271–281.
- van Bergen, E., van Zuijen, T., Bishop, D., & de Jong, P. F. (2016). Why are home literacy environment and children's reading skills associated? What parental skills reveal. *Reading Research Quarterly, 52*, 147–160.
- van Steensel, R. (2006). Relations between socio-cultural factors, the home literacy environment and children's literacy development in the first years of primary education. *Journal of Research in Reading, 29*, 367–382.
- Vasilyeva, M., Dearing, E., Ivanova, A., Shen, C., & Kardanova, E. (2018). Testing the family investment model in Russia: Estimating indirect effects of SES and parental beliefs on the literacy skills of first graders. *Early Childhood Research Quarterly, 42*, 11–20.
- Wagner, R., Torgesen, J., & Rashotte, C. A. (1999). *CTOPP: Comprehensive Test of Phonological Processing*. Austin, TX: PRO-ED.
- Wagner, R. K., Torgesen, J., Rashotte, C. A., & Pearson, N. (2010). *Test of Silent Reading Efficiency and Comprehension*. Austin, TX: Pro-Ed.
- Wang, Y., Lam, S. S.-Y., Mo, J., & McBride-Chang, C. (2014). Pinyin knowledge as a potentially marker of early literacy. In K. K. H. Chung, K. C. P. Yuen, & D. M. McInerney (Eds.), *Understanding developmental disorders of auditory processing, language and literacy across languages: International perspectives* (pp. 189–206). Charlotte, NC: Information Age Publishing.
- Zhang, S.-Z., Georgiou, G., Xu, J.-N., Liu, J.-M., Li, M., & Shu, H. (2018). Different measures of print exposure predict different aspects of vocabulary. *Reading Research Quarterly, 53*, 443–454.
- Zhang, X., Hu, B. Y., Ren, L., Huo, S., & Wang, M. (2019). Young Chinese children's academic skill development: Identifying child-, family-, and school-level factors. In Y. Liu (Ed.), *Child and adolescent development in China. New directions for child and adolescent development* (Vol. 163, pp. 1–29). Hoboken: Wiley.
- Zhang, Y., Jin, X., Shen, X., Zhang, J., & Hoff, E. (2008). Correlates of early language development in Chinese children. *International Journal of Behavioral Development, 32*, 145–151.
- Zhu, C., & Yang, L. H. (2003). Investigation about the early home reading education. *Early Education, 7*, 2–3. [in Chinese].

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